

Defense Forensic Science Center

A Novel Approach for Quantifying the Weight of Fingerprint Evidence



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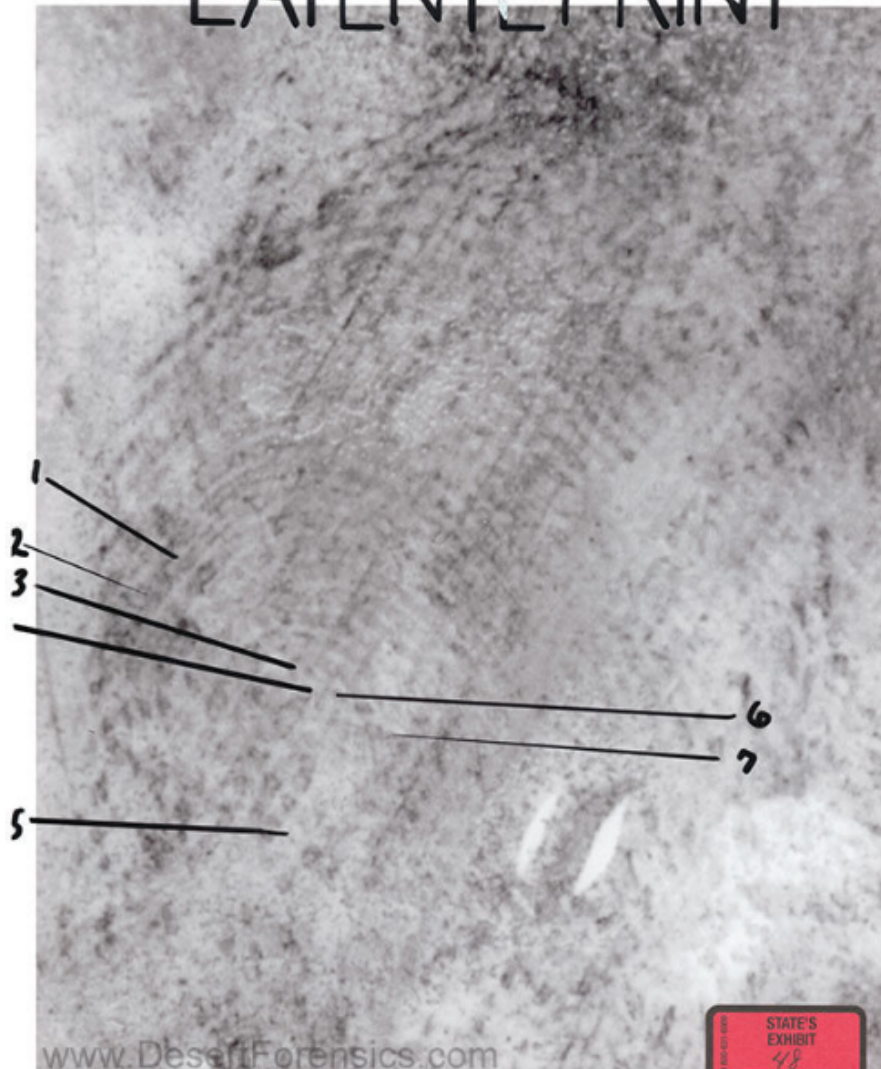
Fingerprint Examination



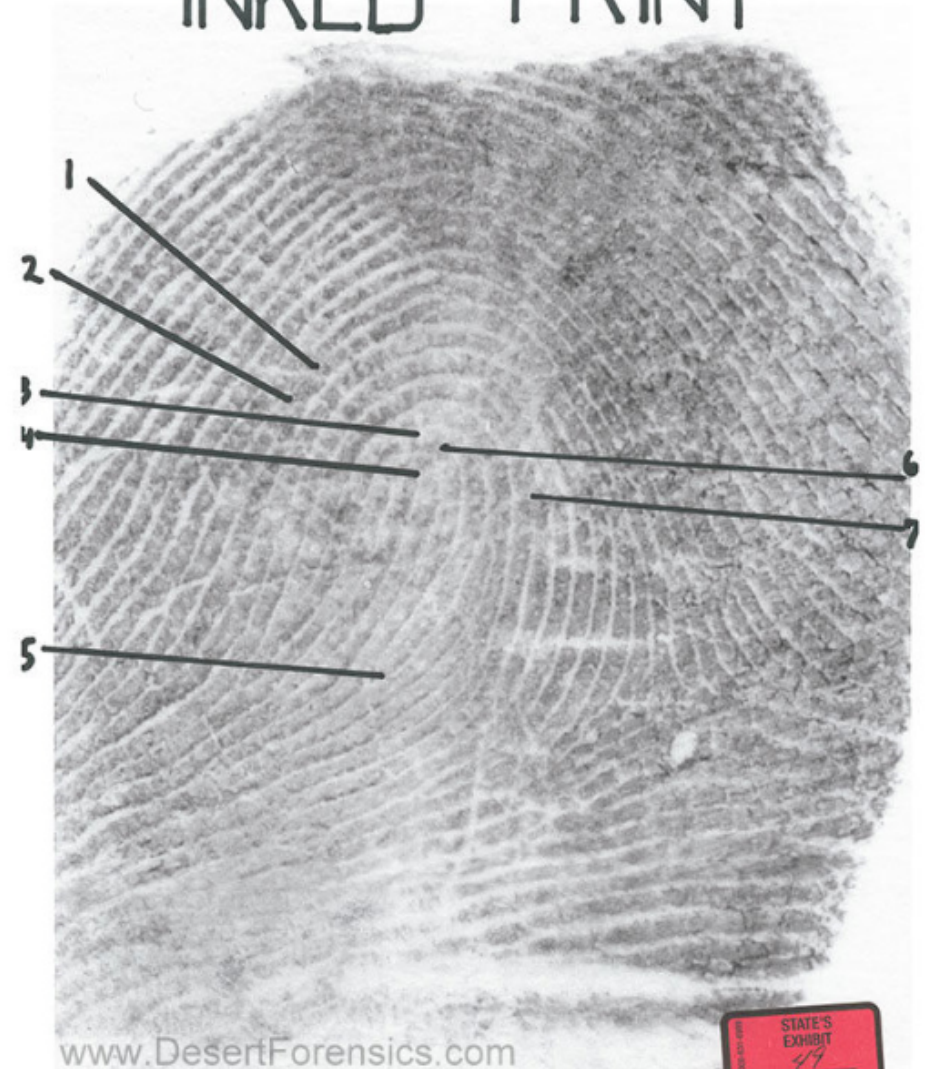


Fingerprint Examination

LATENT PRINT



INKED PRINT





Lana Canen



Convicted of murder on the basis of a single fingerprint identification.

Exonerated in 2012 after spending 8 years in prison.



Quality Assurance



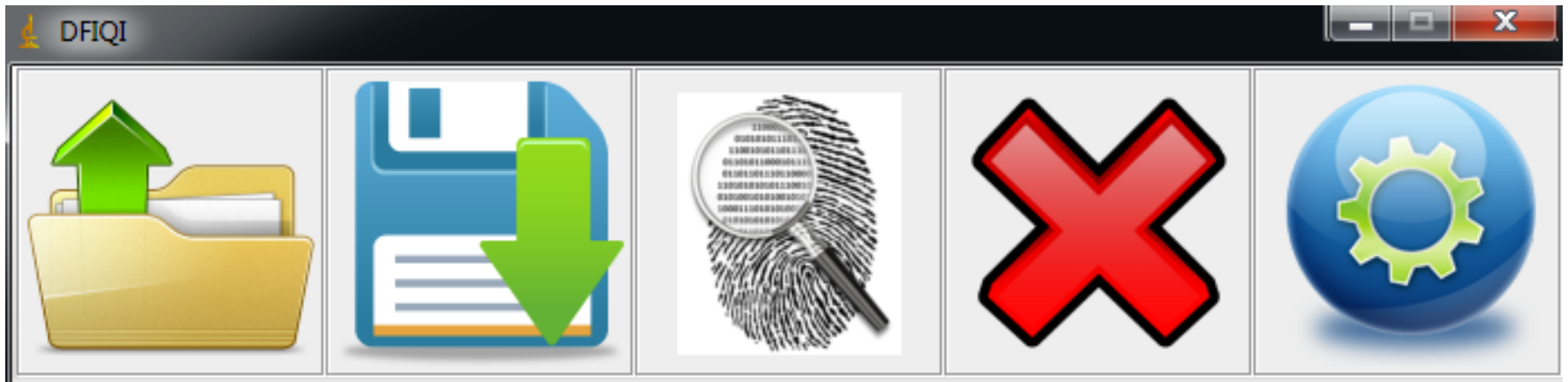


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DFIQI



Defense Fingerprint Image Quality Index (DFIQI)



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How much distortion is tolerable?

Minutiae movement due to skin elasticity:

- Live Scan to record prints once distortion is applied.
- Recorded the #1, 2 and 3 fingers.
- Ten (10) different donors (male and female).
- Eleven (11) different lateral movements and twists applied to each finger independently.



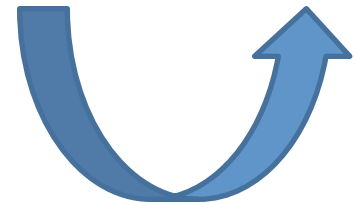
Direction of
Force Applied



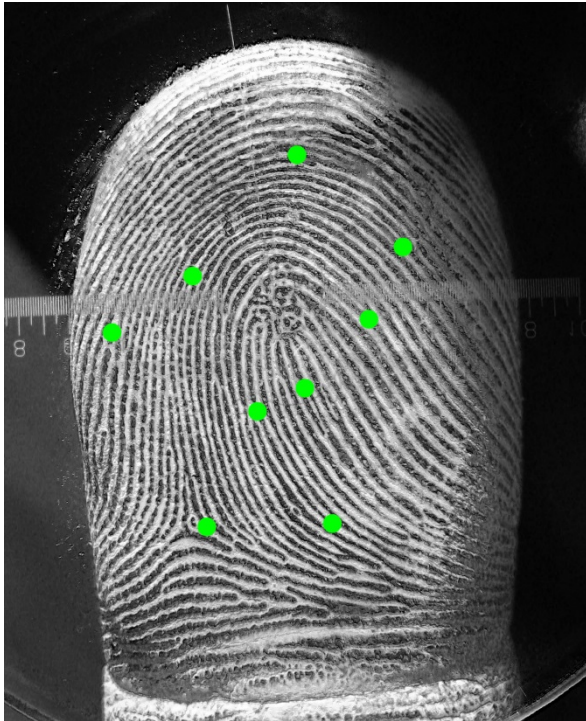
How much distortion is tolerable?



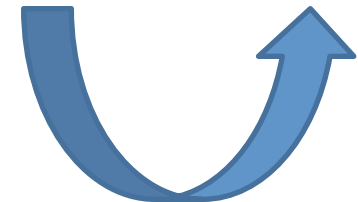
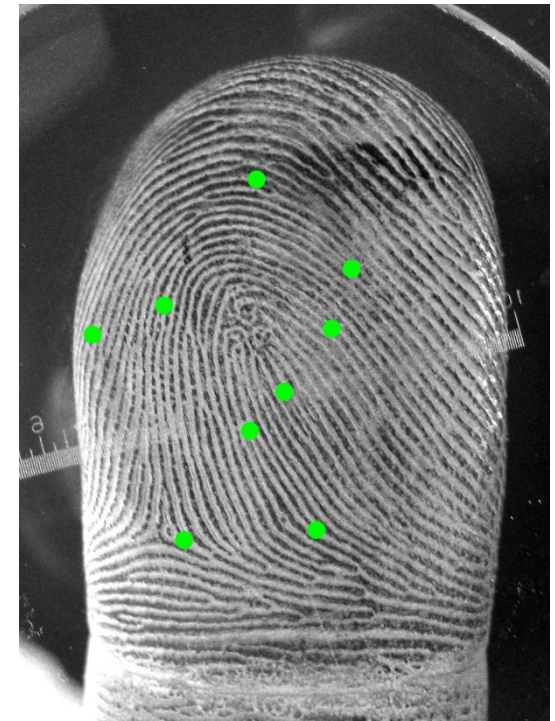
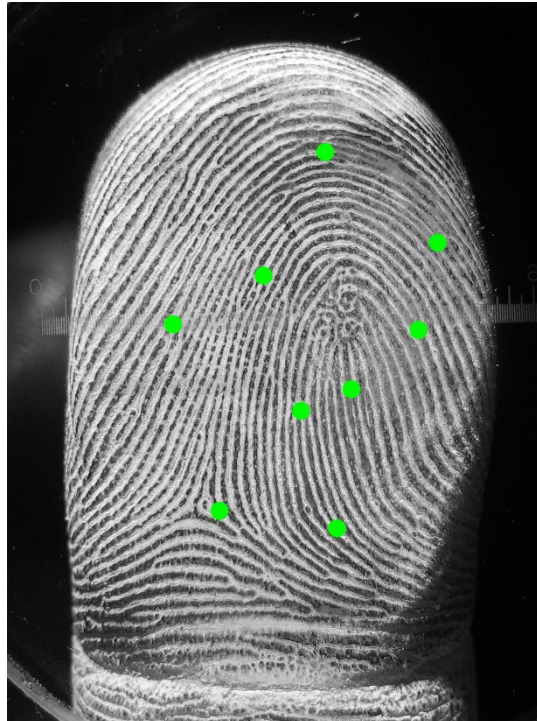
Plain



How much distortion is tolerable?



Plain



How much distortion is tolerable?

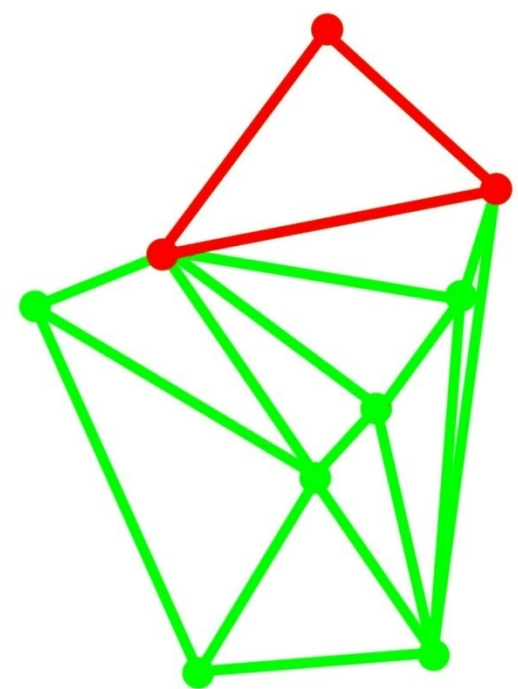
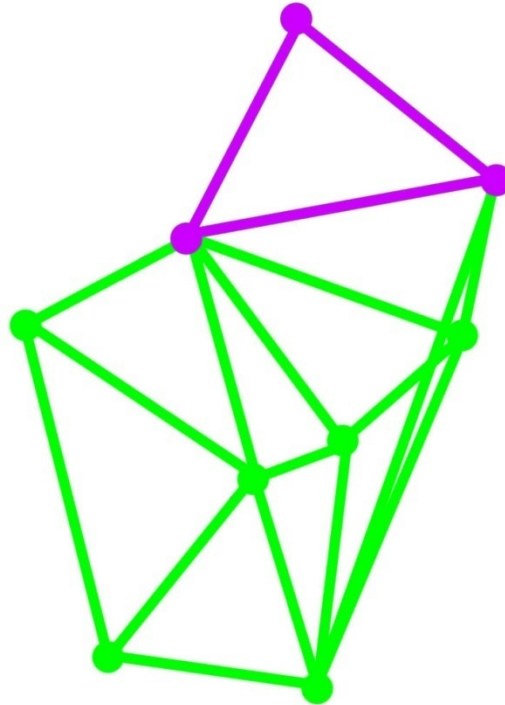
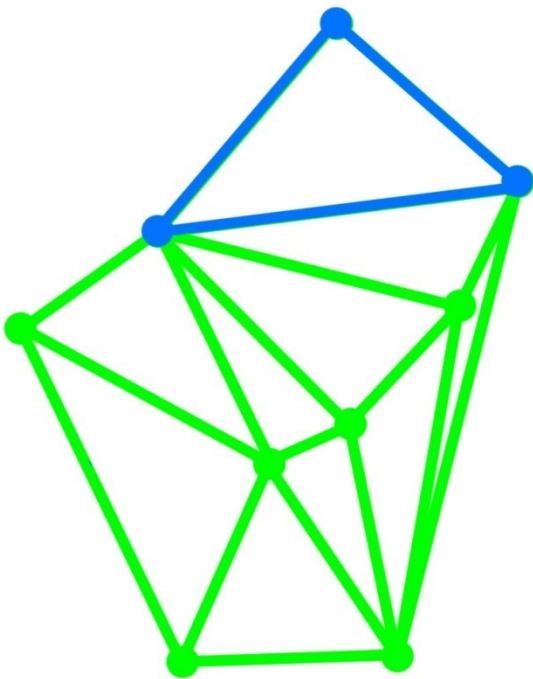


Plain



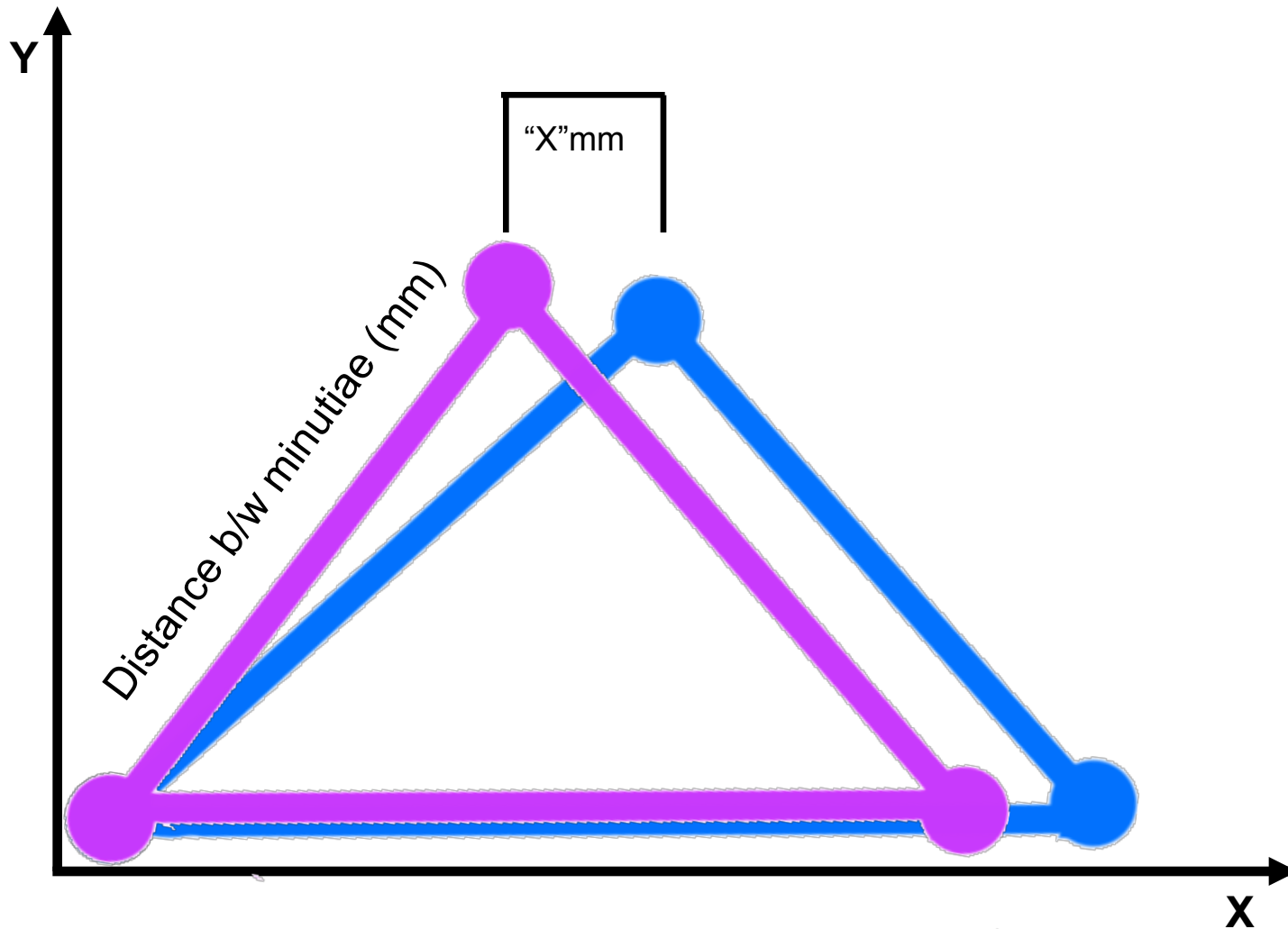


How much distortion is tolerable?



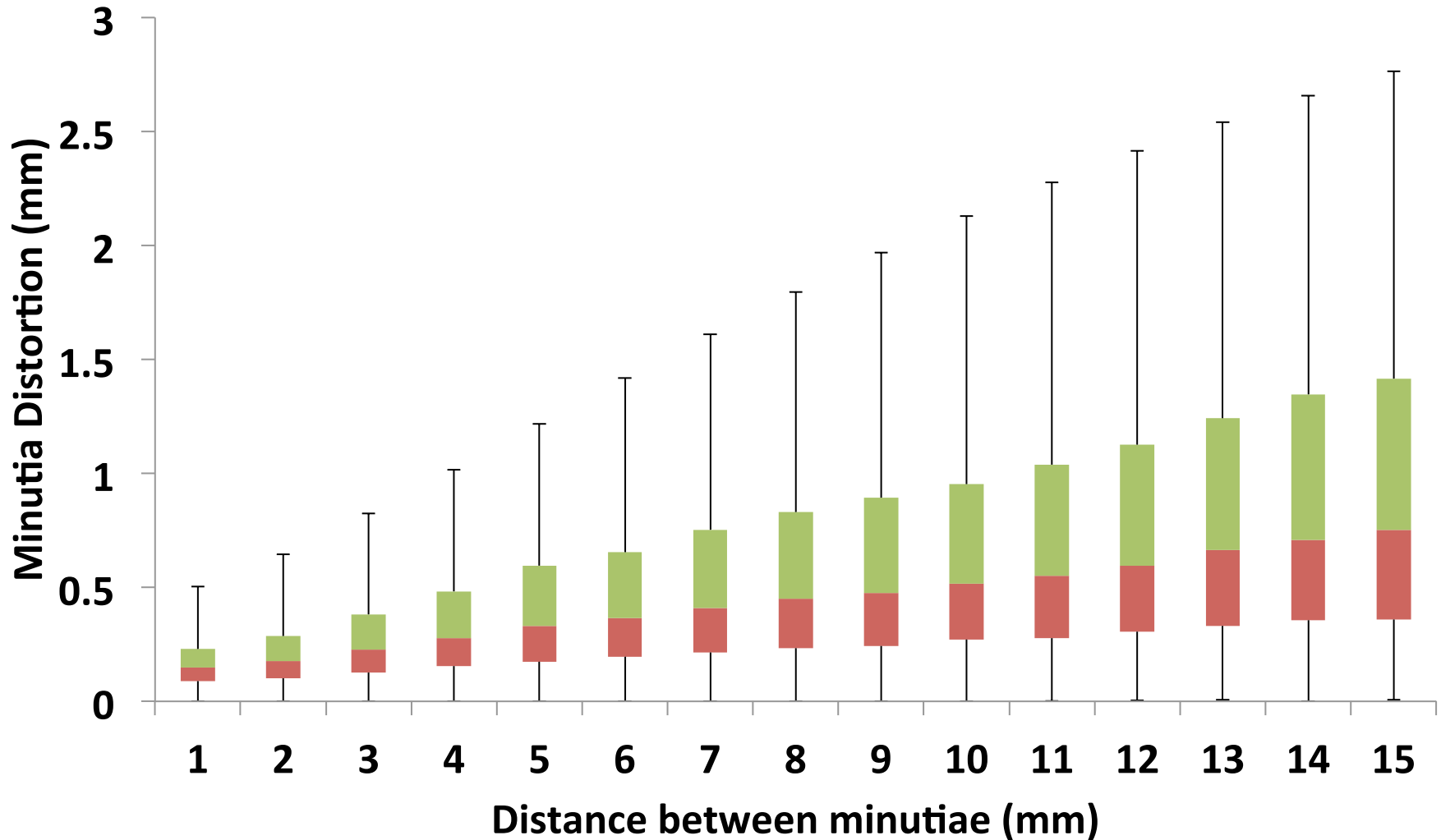


How much distortion is tolerable?



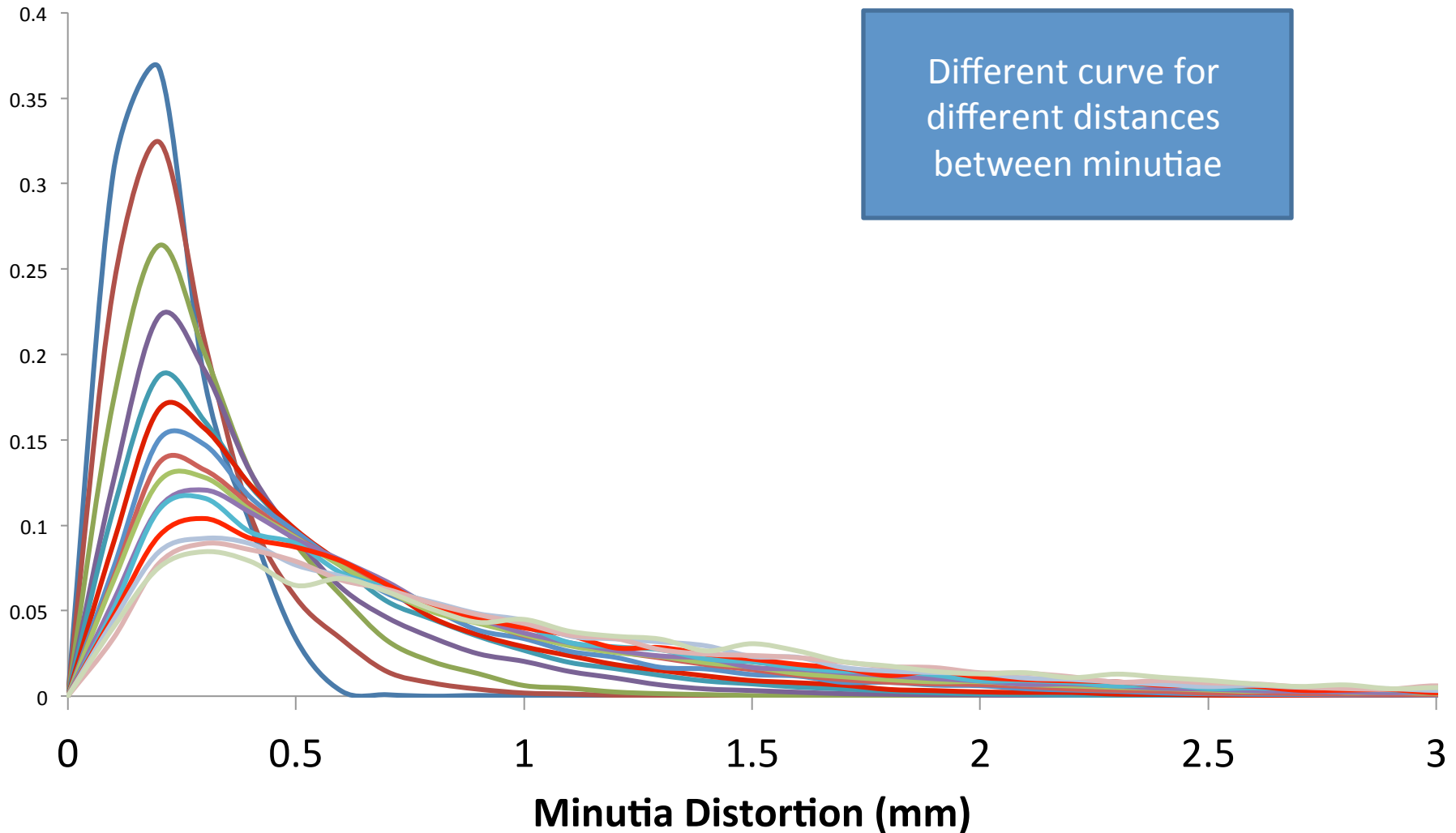


How much distortion is tolerable?





How much distortion is tolerable?



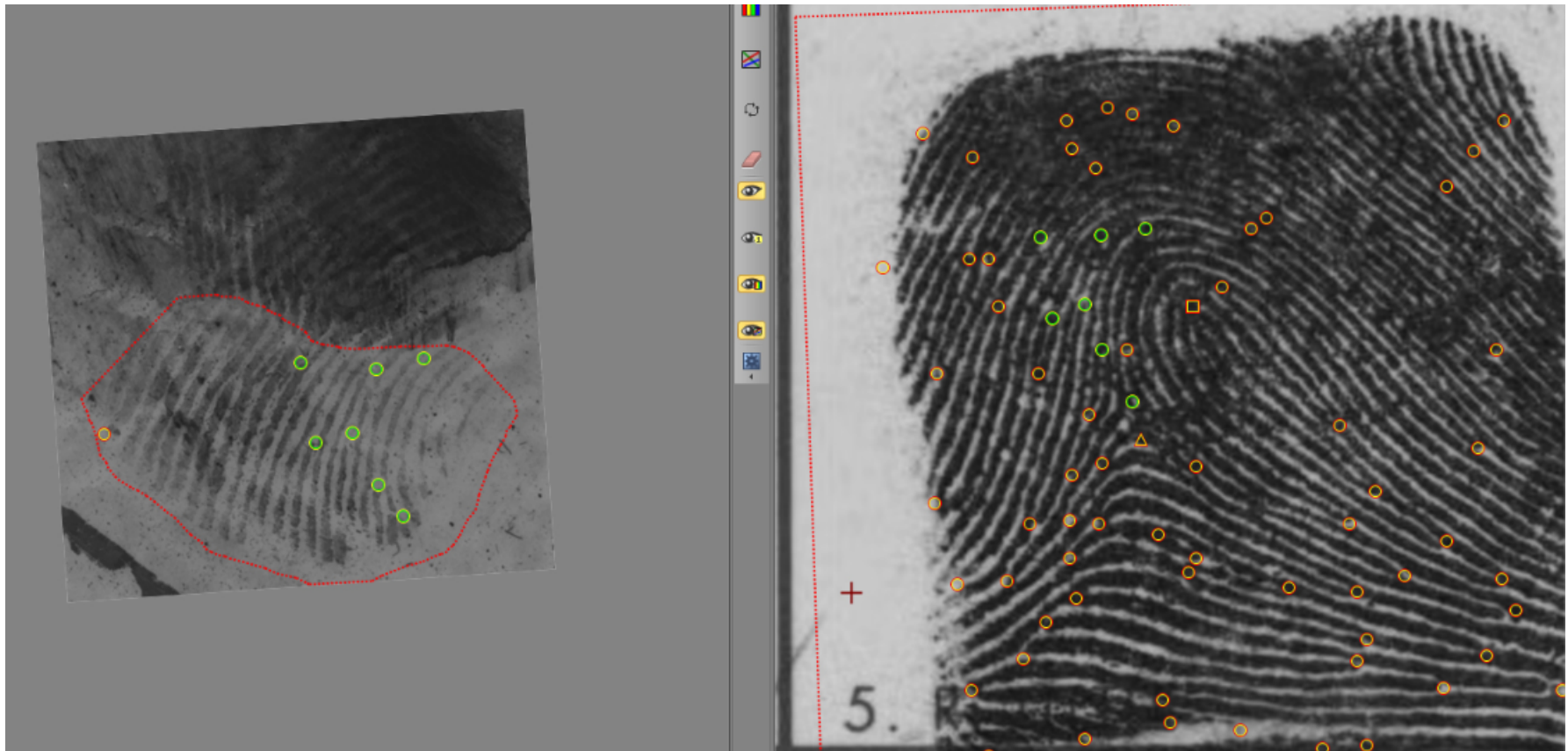


DFIQI Scores for SS & CNM Selection

Evaluated by selecting 25 previous searches of latent prints through NGI (containing ~100 million individuals (~1 billion fingerprints)*. The top 1 and 2 candidates were selected and the features annotated by the system to “correspond” were compared.

*FBI monthly fact sheet – March 2015

https://www.fbi.gov/about-us/cjis/fingerprints_biometrics/ngi/next-generation-identification-monthly-fact-sheet

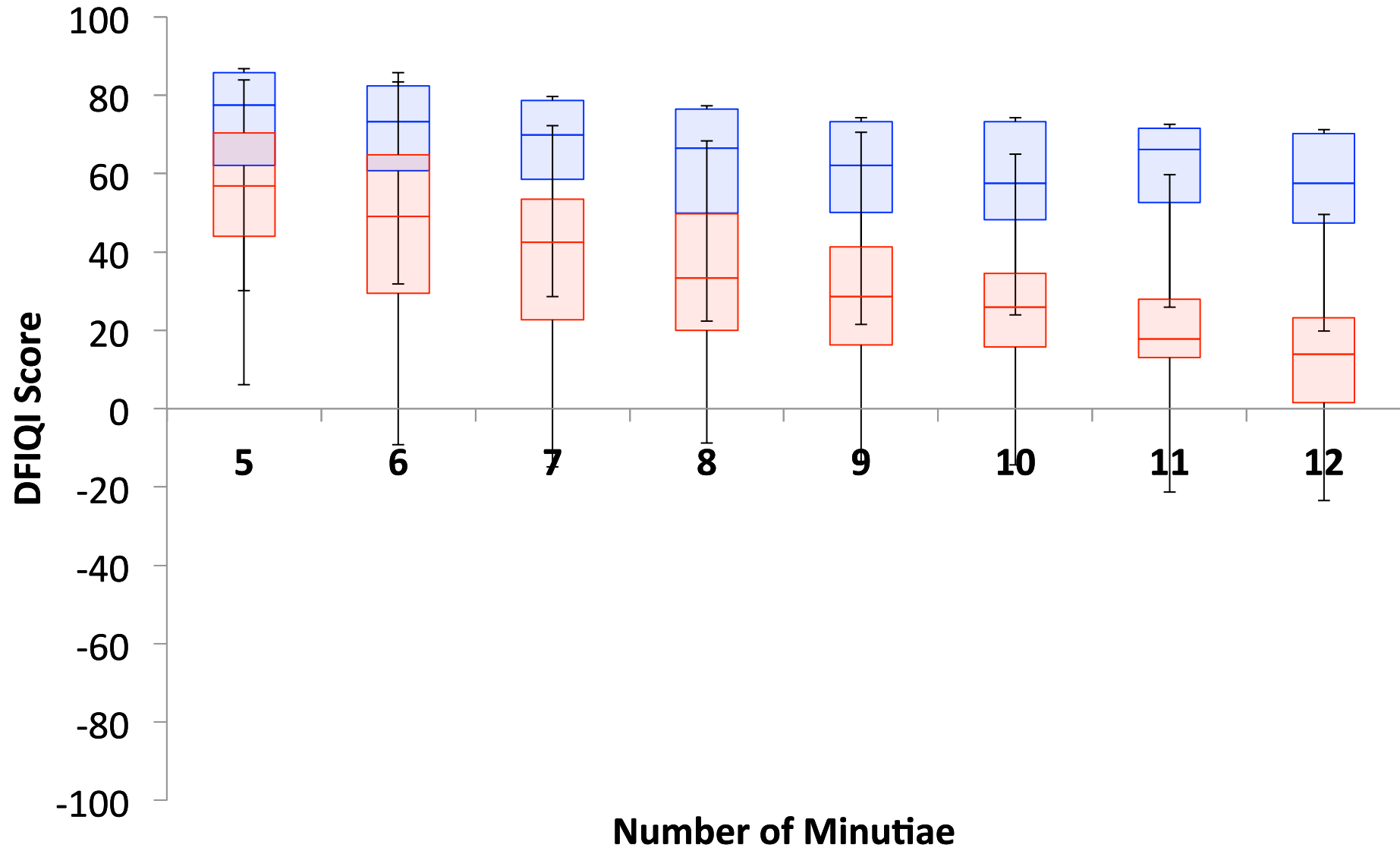




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DFIQI Scores for SS & CNM Selection

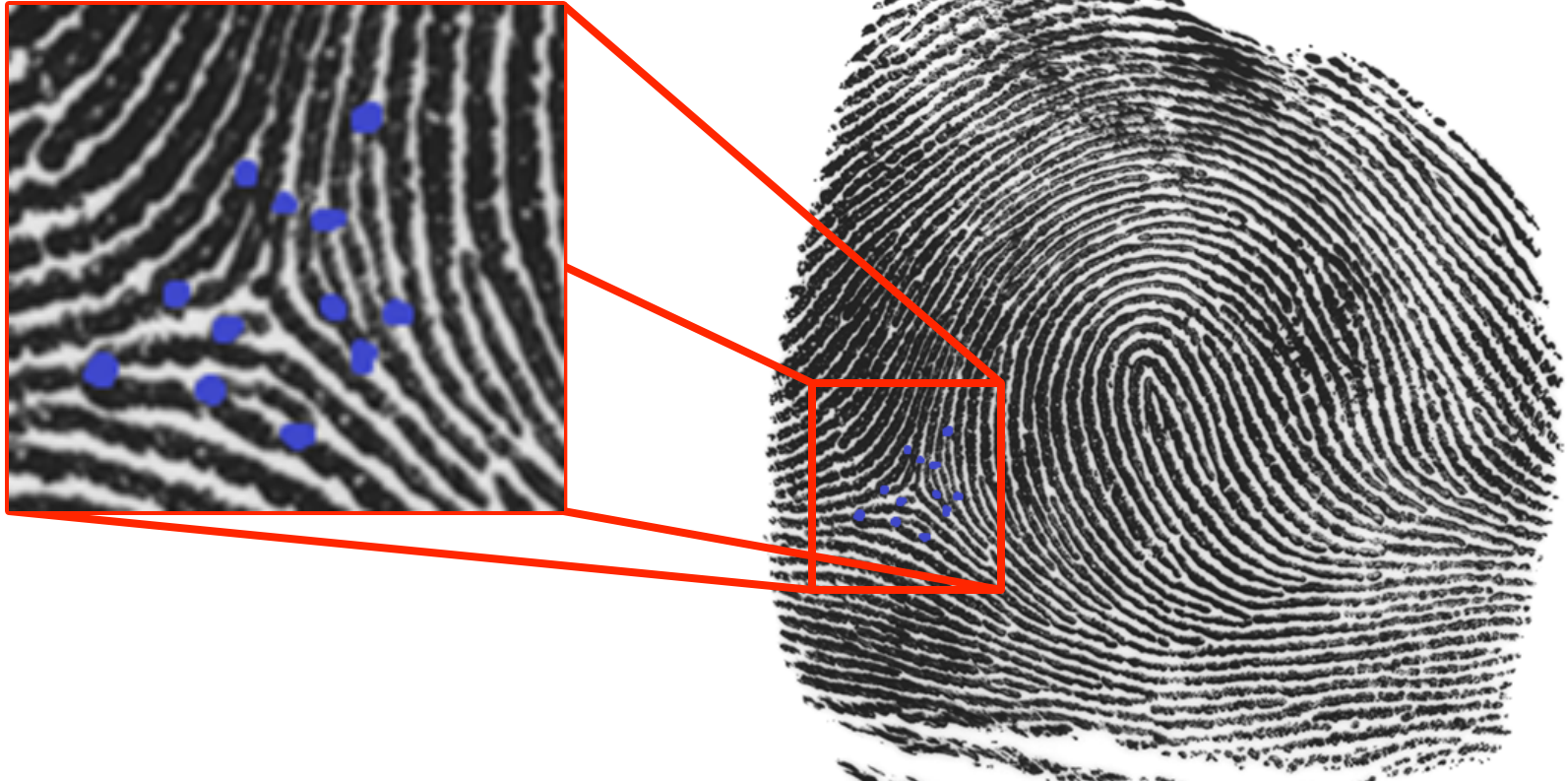


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DFIQI Scores for SS & Random Selection

Evaluated by selecting 50 different record prints at random. Centered on the delta and radiating outward, the first 12 features were annotated. The prints were randomly paired and fifty different comparisons were made.

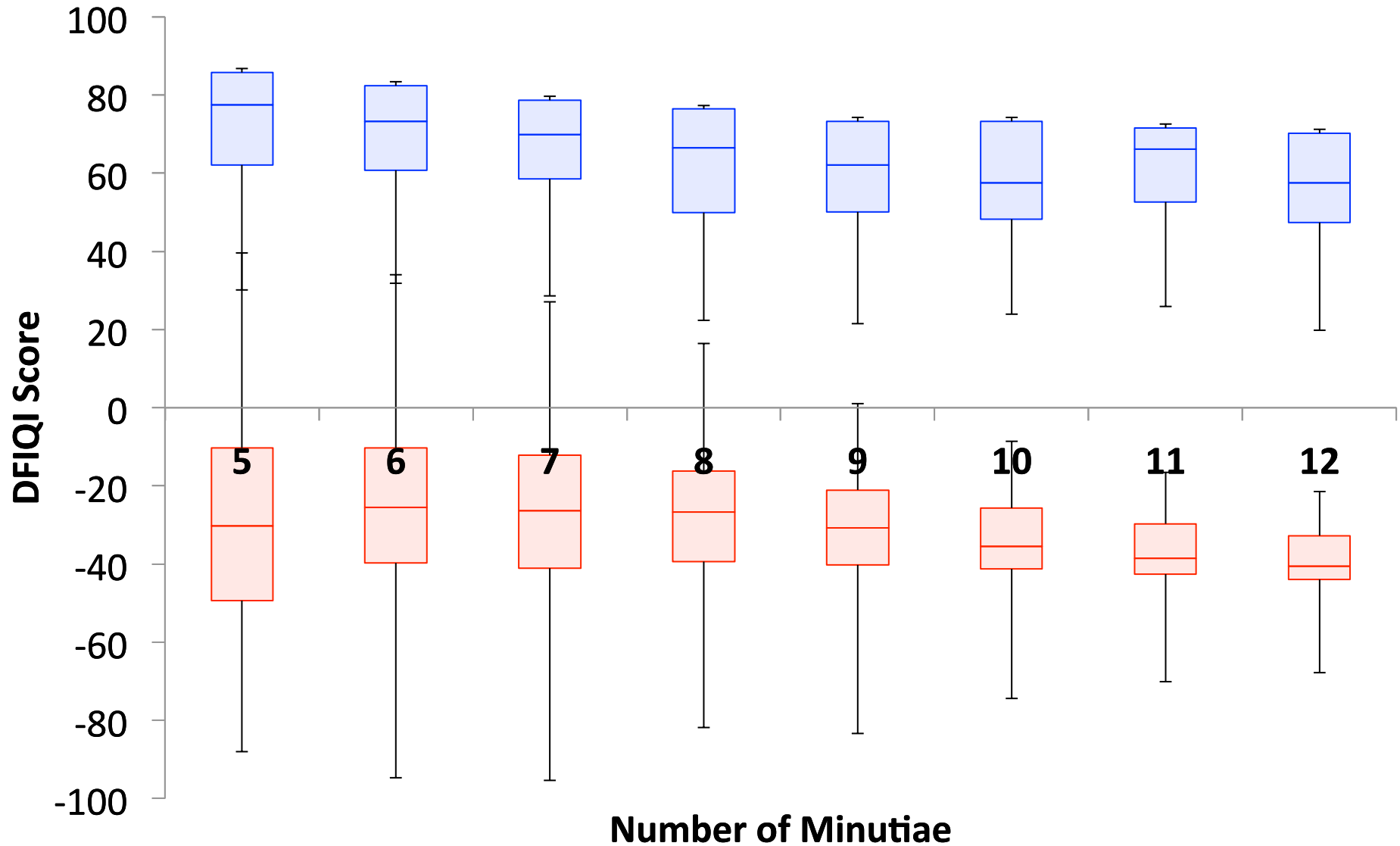




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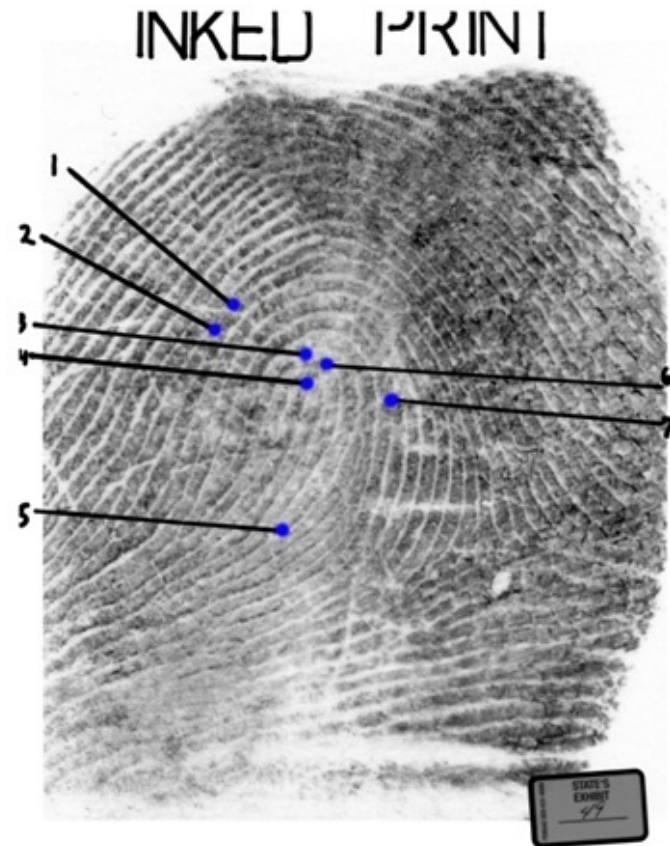
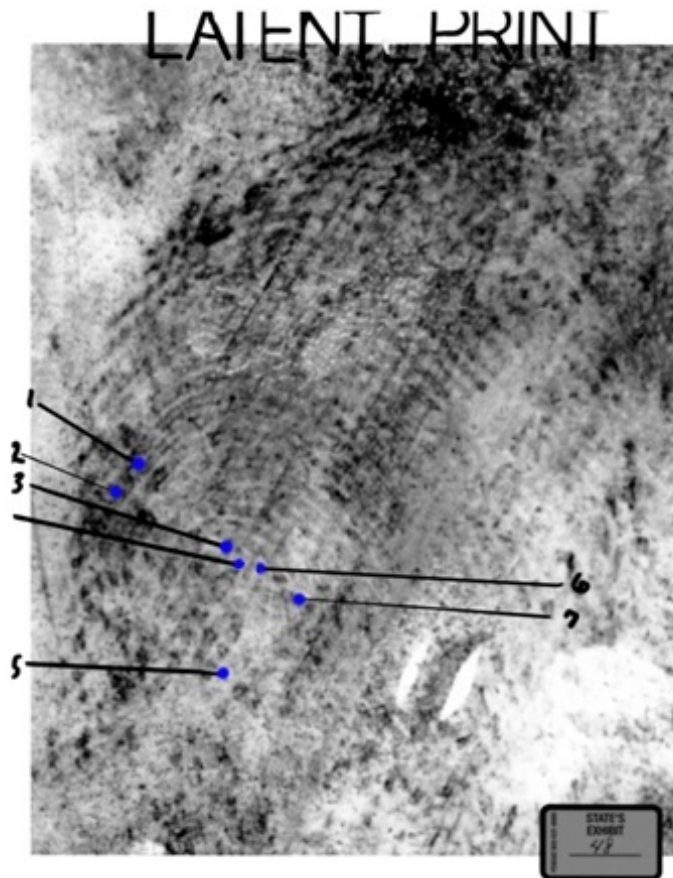
DFIQI Scores for SS & Random Selection



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Canen Comparison



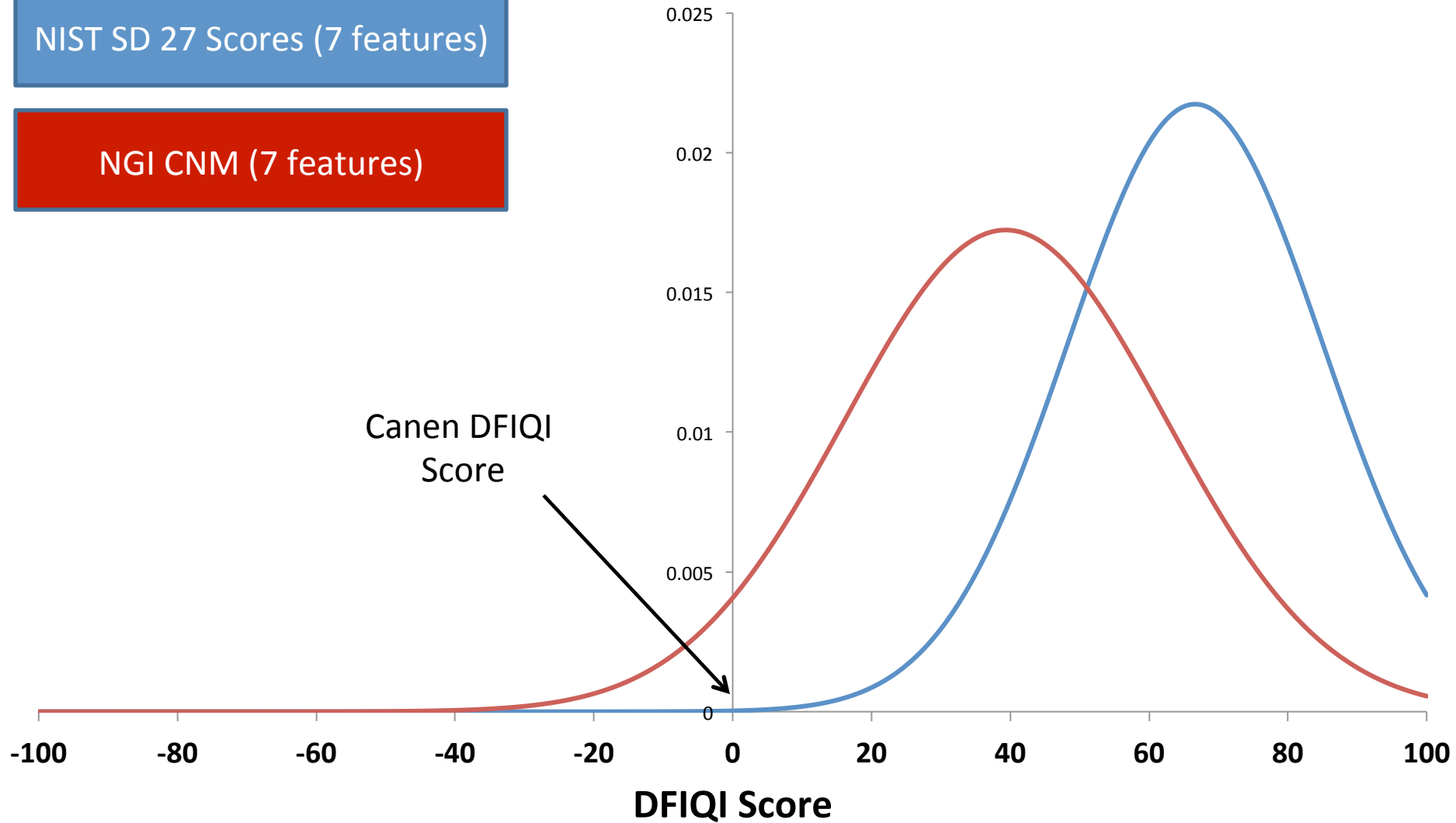
"Close non-match" DFIQI GNoS Score = 2.3036
Score does **NOT** support same source



DFIQI Scores for CNM & SS

NIST SD 27 Scores (7 features)

NGI CNM (7 features)

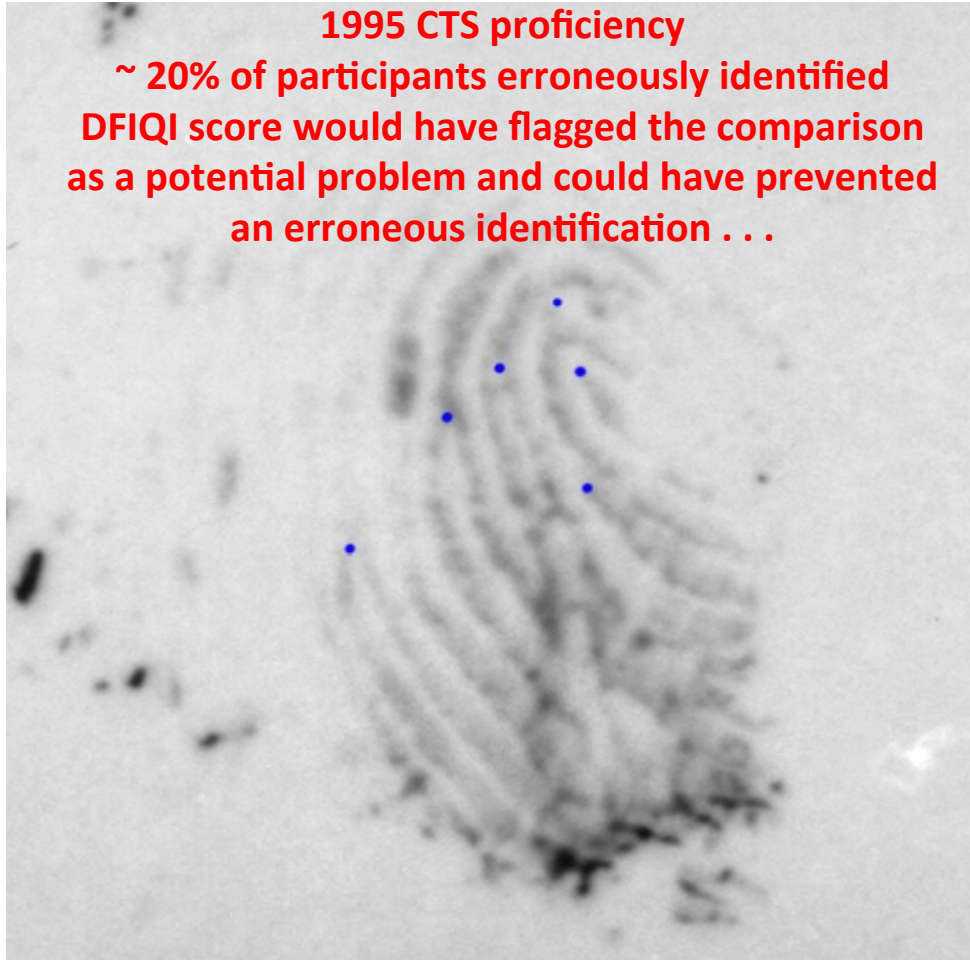




1995 Proficiency (Twin Print)

1995 CTS proficiency

~ 20% of participants erroneously identified
DFIQI score would have flagged the comparison
as a potential problem and could have prevented
an erroneous identification . . .



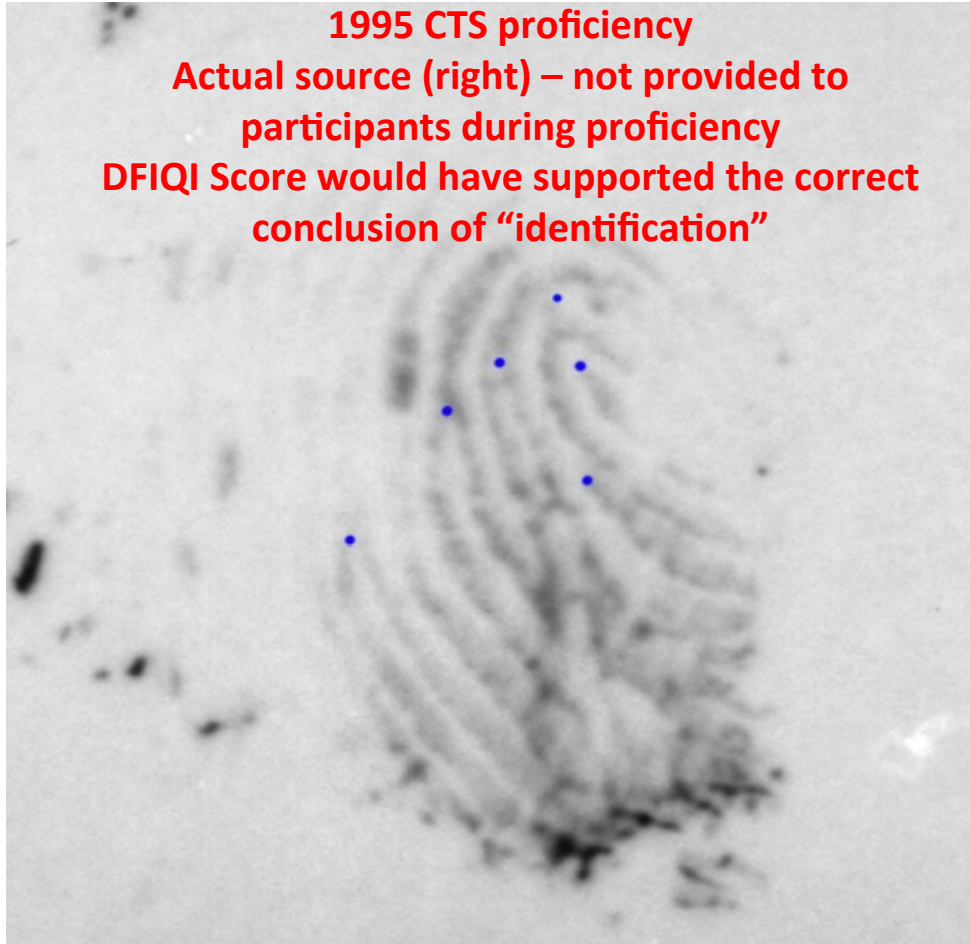
“Close non-match” (twin) DFIQI GNoS Score = 24.43
Score does **NOT** support same source



1995 Proficiency (Twin Print)

1995 CTS proficiency

Actual source (right) – not provided to participants during proficiency
DFIQI Score would have supported the correct conclusion of “identification”



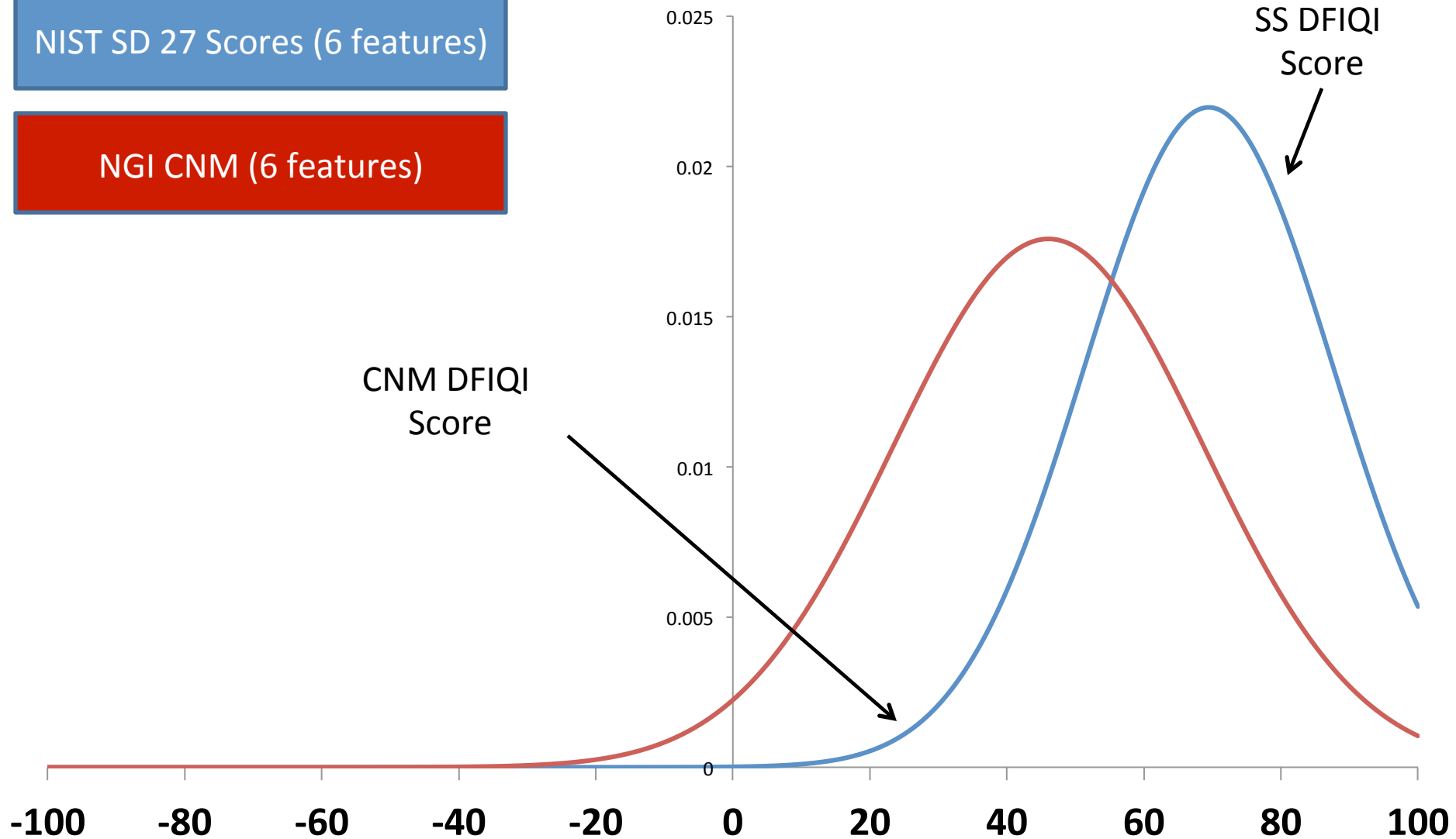
Match (actual source) DFIQI GNoS Score = 77.32
Score supports Same Source



1995 Print vs AFIS CNM & SS

NIST SD 27 Scores (6 features)

NGI CNM (6 features)





Conclusion

AFIS technology has brought on a new era of fingerprint challenges – greater access to increasingly similar feature configurations.

DFIQI or other statistical models may assist fingerprint examiners in their evaluation of the likelihood of source attribution.

Quantitative results provide technical management an effective, transparent, and robust mechanism for error management, detection, and mitigation.

Data may be used to define and standardize decision thresholds throughout laboratory, community



Acknowledgement

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